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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/544,129

08/02/2005

Satoshi Takei

124936

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25944 7590 10/04/2010  
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EXAMINER

EOFF, ANCA

ART UNIT

PAPER NUMBER

1795

NOTIFICATION DATE

DELIVERY MODE

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ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

OfficeAction25944@oliff.com  
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<b>Office Action Summary</b>	<b>Application No.</b> 10/544,129	<b>Applicant(s)</b> TAKEI ET AL.	
	<b>Examiner</b> ANCA EOF	<b>Art Unit</b> 1795	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 02 September 2010.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1, 2 and 6-10 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2 and 6-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                    | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)         | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                          |

### **DETAILED ACTION**

1. Claims 1, 2 and 6-10 are pending in the application. Claims 3-5 have been cancelled.
2. The foreign priority document JP 2003-044045, filed on February 21, 2003 was received and acknowledged.

### ***Continued Examination Under 37 CFR 1.114***

3. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on September 02, 2010 has been entered.

### ***Claim Objections***

4. Claims 1 and 2 are objected to because of the following informalities: the limitation "propylene glycol, monomethyl ether acetate" should read "propylene glycol monomethyl ether acetate" (see par.0036 of the specification).

The formula (2) in claim 2 should be corrected to delete the carbon atom linking the backbone to the group  $\text{-C(=O)-}$  (see par.0030 of the specification).

Appropriate correction is required.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1, 2, 6 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takei et al. (WO 02/05035, wherein the citations are from the English equivalent document, US 2003/0146416).

With regard to claims 1, Takei et al. disclose a composition for forming a gap-filling material for lithography, wherein said material is used for producing semiconductor devices by a method using the gap filling material to apply the resist on a substrate having holes with an aspect ratio of 1 or more, to transfer images onto the substrate by utilization of lithographic process (abstract).

The composition for forming a gap-filling material comprises:

- a polymer (abstract),
- a solvent, such as cyclohexanone, propylene glycol monobutyl ether or propylene glycol monomethyl ether acetate (abstract, par.0097) and
- a crosslinking agent (par.0095).

Takei et al. further disclose that the polymer is preferably a polymer that contains at least one or more hydroxyl groups per repeating unit and it is obtained by polymerizing compounds such as hydroxyalkyl acrylates or hydroxyalkyl methacrylates (par.0061).

Takei et al. also show that the polymer may be a homopolymer (par.0087).

As hydroxyalkyl acrylates, Takei et al. specifically disclose:

- hydroxyethyl acrylate (par.0064), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a hydrogen atom,  $p=1$ ,  $q=0$  and  $R_2$  is a hydrogen atom;

- hydroxypropyl acrylate (par.0064), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a hydrogen atom,  $p=2$ ,  $q=0$  and  $R_2$  is a hydrogen atom, and

- hydroxybutyl acrylate (par.0064), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a hydrogen atom,  $p=3$ ,  $q=0$  and  $R_2$  is a hydrogen atom.

As hydroxyalkyl methacrylates, Takei et al. specifically disclose:

- hydroxyethyl acrylate (par.0065), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a methyl group,  $p=1$ ,  $q=0$  and  $R_2$  is a hydrogen atom;

- hydroxypropyl acrylate (par.0065), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a methyl group,  $p=2$ ,  $q=0$  and  $R_2$  is a hydrogen atom, and

- hydroxybutyl acrylate(par.0065), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a methyl group,  $p=3$ ,  $q=0$  and  $R_2$  is a hydrogen atom.

Takei et al. further disclose that the weight average molecular weight of the polymer is preferably between 1,000 and 30,000 (par.0060), which encompasses the range for molecular weight of the instant application.

Takei et al. do not specifically disclose the polymer of claim 1.

However, it would have been obvious to one of ordinary skill in the art at the time of the invention to obtain such a polymer, based on Takei's teachings that polymers comprising at least one hydroxyl group per repeating unit may be homopolymers, they may be obtained by polymerizing hydroxyalkyl (meth)acrylates and the teaching regarding the preferred weight average molecular weight of the polymers (par.0060).

In Synthetic Example 2 (par.00119-0120), Takei et al. disclose a polymer having weight average molecular weight of 19,000. This polymer gives good planarizing results (see Examples 7-11 in par.0140-0144 and par.0164-0165).

Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to obtain polymers with weight average molecular weight close to this value. Such polymers will satisfy the limitation of "containing components having a molecular weight of 3,000 or less in a rate of 20% or less".

With regard to claim 2, Takei et al. disclose a composition for forming a gap-filling material for lithography, wherein said material is used for producing semiconductor devices by a method using the gap filling material to cover the resist on a substrate having holes with an aspect ratio of 1 or more, to transfer images onto the substrate by utilization of lithographic process (abstract).

The composition for forming a gap-filling material comprises:

- a polymer (abstract),
- a solvent, such as cyclohexanone, propylene glycol monobutyl ether or propylene glycol monomethyl ether acetate (abstract, par.0097) and
- a crosslinking agent (par.0095)

Takei et al. further disclose that the polymer is preferably a polymer that contains at least one or more hydroxyl groups per repeating unit and may be obtained by polymerizing compounds such as hydroxyalkyl acrylates or hydroxyalkyl methacrylates (par.0061).

As hydroxyalkyl acrylates, Takei et al. specifically disclose:

- hydroxyethyl acrylate (par.0064), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a hydrogen atom,  $p=1$ ,  $q=0$  and  $R_2$  is a hydrogen atom;

- hydroxypropyl acrylate (par.0064), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a hydrogen atom,  $p=2$ ,  $q=0$  and  $R_2$  is a hydrogen atom, and

- hydroxybutyl acrylate (par.0064), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a hydrogen atom,  $p=3$ ,  $q=0$  and  $R_2$  is a hydrogen atom.

As hydroxyalkyl methacrylates, Takei et al. specifically disclose:

- hydroxyethyl acrylate (par.0065), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a methyl group,  $p=1$ ,  $q=0$  and  $R_2$  is a hydrogen atom;

- hydroxypropyl acrylate (par.0065), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a methyl group,  $p=2$ ,  $q=0$  and  $R_2$  is a hydrogen atom, and

- hydroxybutyl acrylate(par.0065), which is equivalent to the monomer of formula (1) of the instant application, wherein  $R_1$  is a methyl group,  $p=3$ ,  $q=0$  and  $R_2$  is a hydrogen atom.

Takei et al. further disclose that the above-mentioned polymer may comprise an uncrosslinkable monomer, so that the dry-etching speed and reflectivity can be finely adjusted (par.0071) The uncrosslinkable monomers include alkyl acrylates and alkyl methacrylates having alkyl groups of 1 to 10 carbon atoms (par.0071 and par.0073-0074), which are equivalent to the monomers of formula (2) of the instant application, wherein  $R_1$  is a hydrogen atom or a methyl group and  $R_3$  is an alkyl group with 1-10 atoms.

Takei et al. further disclose that the weight average molecular weight of the polymer is preferably between 1,000 and 30,000 (par.0060), which encompasses the range of the instant application.

Takei et al. do not specifically disclose the polymer of claim 2.

However, it would have been obvious to one of ordinary skill in the art at the time of the invention to obtain such a polymer, based on Takei's teachings that polymers comprising at least one hydroxyl group per repeating unit may be obtain by co-polymerizing hydroxyalkyl (meth) acrylates with uncrosslinkable monomers, such as alkyl (meth) acrylates in order to finely adjust the reflectivity and dry etching speed



(par.0061 and par. 0071) and the teaching regarding the preferred weight average molecular weight of the polymers (par.0060).

In the Synthetic Example 2, Takei et al. show a polymer comprising a monomer with hydroxyl group (hydroxystyrene/p-vinyl phenol) in a molar ratio of 0.49 and an uncrosslinkable monomer (methyl methacrylate) in a molar ratio of 0.51 (par.0120 and par.0061 and par.0066 for the definition of hydroxystyrene/p-vinyl phenol as monomer with a hydroxyl group).

The hydroxystyrene/p-vinyl phenol and the hydroxyalkyl (meth)acrylates are functionally equivalent as monomers with hydroxy groups (par.0061 and par.0066).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to obtain polymer comprising a repeating unit containing a hydroxyl group in a molar ratio of 0.49 and an uncrosslinkable monomer in a molar ratio of 0.51, wherein the repeating unit containing a hydroxyl group may be hydroxyalkyl (meth)acrylates and the uncrosslinkable monomer may be an alkyl (meth)acrylate.

In Synthetic Example 2 (par.0119-0120)), Takei et al. disclose a polymer having weight average molecular weight of 19,000. This polymer gives good planarizing results (see Examples 7-11 in par.0140-0144 and par.0164-0165).

Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to obtain polymers with weight average molecular weight close to this value. Such polymers will satisfy the limitation of "containing components having a molecular weight of 3,000 or less in a rate of 20% or less".

With regard to claim 6, Takei et al. disclose that the crosslinker used for the composition for forming gap-filling material has at least two cross-linking forming functional groups (par.0095).

With regard to claims 8-10, Takei et al. disclose a semiconductor device manufacturing method comprising the following steps:

- a step (A) in which the composition for gap-filling material is applied to a substrate having holes with an aspect ratio or 1 or above and then is dried to form a planarized filling layer on the substrate (par.0107);
- a step (B) in which the resist is applied and dried (par.01018), and
- a step (C) in which an exposure and development are performed (par.0109).

Takei et al. also disclose that a bottom anti-reflective coating can be formed before or after the formation of the filling layer using the composition for forming gap-filling material in the above step (A) (par.0109).

7. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takei et al. (WO 02/05035, wherein the citations are from the English equivalent document, US Pg-Pub 2003/0146416) as applied to claim 1 above and in further view of Rutter et al. (US Pg-Pub 2002/0110665).

With regard to claim 7, Takei et al. teach the composition for forming a gap-filling material of claim 1 (see paragraph 4 of the Office Action) but fail to teach that the composition comprises an acid or an acid generator.

Rutter et al. disclose an aperture fill material, which comprises a cross-linkable polymer with hydroxyl groups, one or more crosslinking agents, one or more acid catalysts and a solvent (par.0007-008).

The acid catalysts are added to the composition to catalyze the crosslinking of the polymer and crosslinking agent (par.0051) and may be free acids or acid generators.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to include the acid catalysts (free acid or acid generators) disclosed by Rutter et al. in the composition for forming a gap-filling material of Takei et al., in order to catalyze the crosslinking of the polymer and crosslinking agent.

### ***Response to Arguments***

8. Applicant's arguments filed on September 02, 2010 have been fully considered but they are not persuasive.

On pages 10-11 of the Remarks, the applicant argues that one of ordinary skill in the art would not have been motivated to look at Takei et al. (WO 02/05035, with citations from US 2003/0146416) and obtain the polymers of claims 1 and 2 because Takei et al. teach several polymers, all of which include phenol groups.

The examiner would like to show that Takei et al. teach that the *preferred* polymers/copolymers for the gap fill material are polymers/copolymers comprising a p-vinylphenol unit (par.0021-0036 and par.0083). The polymers and copolymers comprising p-vinyl phenol units represent several embodiments of Takei et al. (the ninth

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through the sixteenth aspect of the invention of Takei et al., as shown in par.0021-0036).

However, the second aspect of Takei et al. shows a composition for gap-filling material which may comprise a polymer solution having certain properties (par.0014).

This polymer solution may comprise:

- a solvent such as butyl lactate, propylene glycol monobutyl ether acetate, propylene glycol monomethyl ether acetate and cyclohexanone (the seventh aspect of Takei et al., par.0019), and
- a polymer having a weight average molecular weight between 500 and 30,000 (the eight aspect of Takei et al., par.0020).

Takei et al. further teach that is preferred for the polymers to have a weight average molecular weight between 1,000 and 30,000, in order to meet the viscosity requirements for the polymer solution (par.0060). These polymers are preferably polymers comprising 1 or more hydroxyl groups per repeating unit and are obtained by polymerizing compound having one addition polymerization unsaturated bond in the molecule (par.0061). The examples of compounds having one addition polymerization unsaturated bond in the molecule include hydroxyalkyl acrylates and hydroxyalkyl methacrylates (par.0061), such as hydroxyethyl acrylate, hydroxypropyl acrylate, hydroxybutyl acrylate (par.0064), hydroxyethyl methacrylate, hydroxypropyl methacrylate and hydroxybutyl methacrylate (par.0065).

The hydroxyalkyl acrylates and hydroxyalkyl methacrylates are functionally equivalent to the preferred hydroxystyrene/p-vinyl phenol as polymerizing compounds

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for the polymer with 1 or more hydroxyl group per repeating unit (see par.0061 and par.0066 for the definition of the styrene monomers).

Takei et al. further show that the polymers comprising hydroxyl groups may be homopolymers (par.0087).

Therefore, based on the teachings of Takei et al., one of ordinary skill in the art would have been motivated to use a homopolymer of hydroxyalkyl acrylates or hydroxyalkyl methacrylates (hydroxyethyl acrylate, hydroxypropyl acrylate, hydroxybutyl acrylate, hydroxyethyl methacrylate, hydroxypropyl methacrylate and hydroxybutyl methacrylate ) for the gap-filling material. Such homopolymers are equivalent to the polymers consisting of a structural unit of formula (1) of claim 1 of the instant application.

Takei et al. also teach that the polymers may be co-polymers with an uncrosslinkable monomer so that dry etching speed, reflectivity can be finely adjusted (par.0071) and the examples of un-crosslinkable monomers include acrylic and methacrylic esters, such as alkyl acrylates and alkyl methacrylates having an alkyl group with 1-10 carbon atoms (par.0073-0074).

In the Synthesis Example 2, Takei et al. show a copolymer of hydroxystyrene(p-vinyl phenol) and methyl methacrylate (par.0119-0120).

The hydroxyalkyl acrylates and hydroxyalkyl methacrylates are functionally equivalent to hydroxystyrene/p-vinyl phenol as polymerizing compounds for giving the polymer with 1 or more hydroxyl group per repeating unit (see par.0061 and par.0066 for the definition of the styrene monomers).

Therefore, based on the teachings of Takei et al., one of ordinary skill in the art would have been motivated to use a copolymer of hydroxyalkyl acrylates or hydroxyalkyl methacrylates (hydroxyethyl acrylate, hydroxypropyl acrylate, hydroxybutyl acrylate, hydroxyethyl methacrylate, hydroxypropyl methacrylate and hydroxybutyl methacrylate ) with alkyl acrylates or alkyl methacrylates for the gap-filling material.

Such copolymers are equivalent to the polymers consisting of a structural unit of formula (1) and a structural unit of formula (2) of claim 2 of the instant application.

On page 11 of the Remarks, the applicant argues that one of ordinary skill in the art would not have been motivated to look at Takei et al. and obtain the polymers of claims 1 and 2 because the Examples of Takei et al. demonstrate that the compositions prepared with poly(hydroxypropyl methacrylate) have inferior planarizing properties.

On pages 11-12 of the Remarks, the applicant further argues that the Comparative Examples 3 and 4 of Takei et al. teach against the polymers of the instant application.

The applicant shows that the Comparative Example 3 uses a poly(hydroxypropyl methacrylate) having a weight average molecular weight of 130,000 and the Comparative Example 4 uses a copolymer of p-vinyl phenol and methyl methacrylate.

The applicant argues that the Comparative Examples 3 and 4 demonstrate inadequate and inferior planarizing abilities or flattening properties when compared to Examples made without hydroxypropyl methacrylate or methyl methacrylate.

The examiner respectfully disagrees and would like to show the following:

The Comparative Example 3 uses a poly(hydroxypropyl methacrylate) having Mw of 130,000 (par.0147 for Comparative Example 3 and par.0127 for the synthesis of the polymer). This polymer is dissolved in a solvent to form a solution and the viscosity of the solution is 225 mPa (par.0129).

The poly(hydroxypropyl methacrylate) has Mw of 130,000, which is outside the range of 1,000 to 30,000 of Takei et al. (par.0060). In par.0060, Takei et al. clearly teach that the polymers having a molecular weight of more than 30,000 rarely meet the viscosity requirements (viscosity of 1-80 mPa, as shown in par.0053).

It is clear that the high viscosity of the poly(hydroxypropyl methacrylate) solution is determined by the high molecular weight.

The results given by the composition of the Comparative Example 3 are shown in the table in par.0062 and are discussed in par.0163:

TABLE 2

	Coefficient H	Viscosity of the polymer solution (Unit: mPa · s)	Fluorizing factor (Unit: %)		
			iso	Dense	Bias
Example 1	0.041	15	98	93	5
Example 2	0.041	15	96	91	5
Example 3	0.029	8	95	94	4
Example 5	0.046	21	98	97	1
Example 6	0.053	32	89	84	5

TABLE 2-continued

	Coefficient H	Viscosity of the polymer solution (Unit: mPa · s)	Planarizing factor (Unit: %)		
			iso	Dense	Bias
Comparative Example 2	0.069	98	88	72	15
Comparative Example 3	0.079	115	82	51	31

[0163] The planarizing factor of the film obtained from each of the compositions for forming a gap-filling material for lithography of Examples 1 to 3, 5, and 6 was larger than those of Comparative Examples 2 and 3, and in particular the planarizing ability thereof in the Dense patterns was excellent. It is considered that this is caused by an increase in fluidity of the solution in the steps of spinning and baking as the viscosity of the composition for forming a gap-filling material becomes lower.

As clearly shown by Takei in the last sentence of the par.0163, *the viscosity of the solution is responsible for the results.*

For Comparative Example 3, the very high molecular weight of the poly(hydroxypropyl methacrylate) determines very high viscosity of the polymer solution and the inferior results.

There is absolutely no teaching/mention that the inferior results are given by the choice of monomers for the polymers.

The Comparative Example 4 of Takei et al. uses a copolymer of p-vinylphenol and methylmethacrylate and a solvents mixture of PGME and tetrahydrofuran (boiling point 65°C) (par.0148). The Comparative Examples 5 of Takei et al. uses a copolymer of p-vinylphenol and methylmethacrylate and a solvents mixture of PGME and ethyleneglycol dimethyl ether (boiling point 82.5°C) (par.0149).



The results given by the compositions of Comparative Example 4 and 5 are shown in par.0164 and par.0165:

TABLE 3

	Planarizing factor (Unit: nm)		
	iso	Dense	Bias
Example 7	97	94	3
Example 8	96	91	5
Example 9	97	95	2
Example 10	91	73	18
Example 11	90	60	30
Comparative Example 4	87	32	55
Comparative Example 5	89	45	44

[0165] The planarizing factor of the film obtained from the composition for forming a gap-filling material for lithography of each of Examples 7 to 11 was high as compared with that of the film obtained from each of Comparative Examples 4 and 5 and in particular the planarizing ability thereof was excellent in the Dense patterns that requires severe conditions. In each of Comparative Examples 4 and 5, furthermore, the gap-filling-material was adhered along the step in the substrate (a conformal type). In each of Examples 7 to 11, on the other hand, it flows from the vicinity of the hole to the inside of the hole. Therefore, the surface of the substrate covered in accordance with each of Examples 10 to 14 was planarized. In each of Examples 7 to 11, it is considered that the difference in planarizing factor is small as the composition for forming a gap-filling material flows into a plurality of holes with a larger fluidity also in the Dense portion where the number of holes per unit area on the substrate is larger than that of the iso portion. The reason

why the compositions for forming a gap-filling material of Examples 7 to 11 have planarizing factors larger than those of Comparative Examples 4 to 5 is that each of them contains a solvent having a boiling point higher than the glass transition temperature of the polymer or the boiling point of such a solvent is in the range of 145° C. to 220° C.

In the last sentence of the cited par.0165, Takei et al. explains that *the results are due to the choice of solvents*.

Examples 7-11 shown in Table 3 use the same polymer as Comparative Examples 4 and 5 in combination with solvent mixtures of PGME with propyleneglycol monobutyl ether (boiling point of 170.1°C) (par.0140), butyl lactate (boiling point 187°C)

(par.0141), diethyleneglycol monoethylether (boiling point 194.2°C) (par.0142), cyclohexanone (boiling point 155.7°C) (par.0143) and PGMEA (boiling point 146°C) (par.0144).

Par. 0056-0057 of Takei et al. clearly teach that the boiling point of the solvent should be in the range of 145-220°C. The Examples 7-11 comprise solvents having boiling points within this range while Comparative Examples 4 and 5 comprise tetrahydrofuran and ethyleneglycol dimethyl ether, which have boiling points outside the range.

As shown in par.0165, the choice of solvents determines the inferior results in the Comparative Examples 4 and 5.

There is absolutely no teaching/mention of Takei to indicate that the choice of monomers for the polymer is what gives the inferior results.

On page 12 of the Remarks, the applicant further argues that Takei et al. expressly discloses inferior results with respect to a polymer having methacrylate.

The examiner respectfully disagrees: Takei et al. shows a copolymer of p-vinyl phenol and methyl methacrylate in the Synthesis Example 2 (par.0119-0120).

This polymer is used in combination with solvents having boiling points in the preferred range of 145-220°C (see Examples 7-11 in par.0140-0144) and gives very good results (see Table 3 cited above).

The copolymer of copolymer of p-vinyl phenol and methyl methacrylate gives inferior results only when in combination with a solvent having a boiling point outside the

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preferred range of 145-220°C (see Comparative Examples 4-5 in par.0148-0149 and par.0164-0165 cited above).

There is no teaching in Takei et al. against the polymers of the instant application.

Takei et al. clearly shows hydroxyl alkyl acrylates and hydroxyalkyl methacrylates as monomers with hydroxyl groups for the polymer used in the gap filling material (par.0061-0063). Takei et al. further show that the polymers may be homopolymers (par.0087) or copolymer with other uncrosslinkable monomers, such as alkyl (meth)acrylates (par.0071-0074).

Therefore, one of ordinary skill in the art would have been motivated to obtain the polymers of claims 1 and 2 of the instant application, based on the teachings of Takei et al.

On page 12 of the Remarks, the applicant argues that Rutter et al. (2001/0110665) do not cure the deficiencies of Takei et al. and that Rutter et al. is directed to a composition and a method of protecting apertures.

The examiner would like to show that Rutter et al. clearly teach aperture filling materials for planarizing surfaces (par.0001 and par.0006). The composition of Rutter et al. has gap filling capabilities (par.0009) and comprises a polymer with at least one hydroxyl-group containing monomer, solvents, crosslinking agents and acid catalysts (par.0051).

One of ordinary skill in the art would immediately notice that Takei et al. and Rutter et al. both address the same issue (gap filling) and teach compositions with the same type of components.

Therefore, one of ordinary skill in the art would be motivated to modify Takei et al. by including the acid catalyst of Rutter et al. in the gap filling material.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANCA EOFF whose telephone number is (571)272-9810. The examiner can normally be reached on Monday-Friday, 6:30 AM-4:00 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia H. Kelly can be reached on 571-272-1526. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

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/Anca Eoff/

Examiner, Art Unit 1795